

**CLAIMS :**

1. A method for producing DME, which comprises the steps of:

- (i) introducing a feed gas mixture containing hydrogen and CO to a DME  
5 synthesis reactor, wherein the feed gas mixture is reacted in the presence of a  
methanol synthesis catalyst and an acid catalyst for the dehydration of methanol,  
to provide a crude product stream containing DME and CO<sub>2</sub>;  
(ii) separating the crude product stream into a CO<sub>2</sub> rich stream and a DME rich  
stream;  
10 (iii) introducing the CO<sub>2</sub> rich stream to a reverse water gas shift (RWGS)  
reactor wherein it is reacted with hydrogen in the presence of a catalyst to  
provide a CO rich stream, while recovering the DME rich stream as a product;  
and  
(iv) recycling the CO rich stream to step (i).

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2. The method of claim 1, wherein the reaction in the reverse water gas reactor  
is carried out, in the presence of an oxide catalyst, at a temperature ranging  
from 400 to 1,200 °C under a pressure ranging from 1 to 100 atm.

- 20 3. The method of claim 2, wherein the oxide catalyst is ZnO supported on or co-  
precipitated with an oxide selected from Cr<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>, ZrO<sub>2</sub>, MgO, MnO, SiO<sub>2</sub>  
and a mixture thereof, the content of ZnO being 10 to 90 % by weight based on  
the total weight of the catalyst.

- 25 4. The method of claim 3, wherein the ZnO catalyst further comprise an oxide  
of Cu or Mn in an amount of 0.01 to 60 % by weight based on the total weight  
of the catalyst.

5. The method of claim 2, wherein the oxide catalyst is  $\text{MnO}_x$  ( $x=1\sim 2$ ) supported on or co-precipitated with an oxide selected from  $\text{Cr}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{ZrO}_2$ ,  $\text{MgO}$ ,  $\text{SiO}_2$  and a mixture thereof, the content of  $\text{MnO}_x$  being 1 to 99 % by weight, preferably 1 to 40 % by weight based on the total weight of the catalyst.

6. The method of claim 2, wherein the oxide catalyst is an alkaline earth metal oxide supported on or co-precipitated with an oxide selected from  $\text{Cr}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{ZrO}_2$ ,  $\text{MnO}$ ,  $\text{SiO}_2$  and a mixture thereof, the content of alkaline earth metal oxide being 1 to 99 % by weight, preferably 1 to 40 % by weight based on the total weight of the catalyst.

7. The method of claim 6, wherein the oxide catalyst is a hexaaluminate comprised of  $\text{BaO}$ ,  $\text{MgO}$  and  $\text{Al}_2\text{O}_3$  as main components.

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8. The method of claim 2, wherein the oxide catalyst is  $\text{NiO}$  supported on or co-precipitated with an oxide selected from  $\text{Cr}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{ZrO}_2$ ,  $\text{MgO}$ ,  $\text{SiO}_2$  and a mixture thereof, the content of  $\text{NiO}$  being 1 to 20 % by weight, preferably 1 to 10 % by weight based on the total weight of the catalyst.

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9. The method of claim 1, wherein the molar ratio of hydrogen and CO in step (iv) is controlled to 0.9 ~ 1.5: 1.